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ARTICLE

Learning from evidence-based medicine: exclusions and opportunities within health care environments research

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ABSTRACT

The development of evidence-based design (EBD) has been heavily influenced by evidence-based medicine, particularly the research methods and ontological positions associated with it. While EBD is the dominant paradigm within health care environments research, the rules and conditions that determine knowledge production within this field have not been opened to interrogation. This paper examines the value paradigm that underpins evidence-based decision-making and the disciplinary research methods that have been undervalued in the translation of this paradigm from medicine to design. Specifically it will address subjective self-report data and design-based research methods that could serve to productively challenge existing approaches to the design of health care environments. This paper does not aspire to discredit the current practices of EBD but to encourage a broader methodological approach toward an understanding of the relationship between architecture and wellbeing.

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Evidence-based design; research methods; design research; speculative design

Introduction

Evidence-based design (EBD) aspires to obtain concrete evidence to locate and support features of the built environment capable of promoting physiological benefits. Studies within this field predominantly seek a reduction in anxiety for hospital users. This has been shown to support the healing process for patients and improve staff wellbeing with corresponding benefits relative to job performance, particularly patient safety and the quality of care that can be delivered. In its current form, EBD is in urgent need of interrogation. A disparity is evident between the ambitions that underpin this research and the types of findings obtainable via the research methods currently favoured. The direct physiological benefits for patients that EBD seeks to achieve are underpinned by a strong economic imperative to decrease health care costs in respect of an ageing population (with the ramifications of an ageing workforce) increasing rates of obesity, diabetes and depression (Becker, Sweeny, and Parsons 2008; Muhlbauer 2013).

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However, the research methods valued within this field are only capable of producing small, incremental improvements to contemporary design practice, just as evidence-based medicine (EBM) has increasingly become, according to Greenhalgh, Howick, and Maskrey, 'a science of marginal gains' (2014, 3276). Such improvements will not make a significant difference in respect of the enormity of the problem EBD aspires to contribute solutions to.

Within any field, the research methods and ontological positions that are valued act to establish what counts as evidence and what types of evidence count; these determine what kinds of solutions are able to emerge in relation to a problem (Savransky and Rosengarten 2016). Put simply, ingrained disciplinary practices can prevent researchers from asking the very questions that could facilitate significant shifts forward. Salmon, McClure, and Stanton (2012) have offered an example of this limitation within the field of transport safety. Underpinning the methodological approach to investigating road accidents is the assumption that accidents occur owing to one of three factors: the driver, vehicle or roadway. Since the broader context of an accident is never examined, alternative causal factors such as road rules, road design and societal norms, that also exert an influence, remain unacknowledged. The magnitude of these influences thus remains unknown and cannot be addressed by the solutions correspondingly designed to improve transport safety.

In fields where disciplinary practices have been adopted or translated from other contexts, this problem can be compounded by a devaluation of traditional disciplinary understandings and research methods. EBD can be understood as a translation of the principles of EBM[1] to studies of the built environment, with a particular focus on health care facilities. This has resulted in a high value being placed on research methods comparable with that of medicine's Randomized Control Trial (RCT), while traditional research methods, including design research and speculative design, are accorded less significance because they are perceived as too subjective and thus inferior (Figure 1). This approach presents a misfit for research

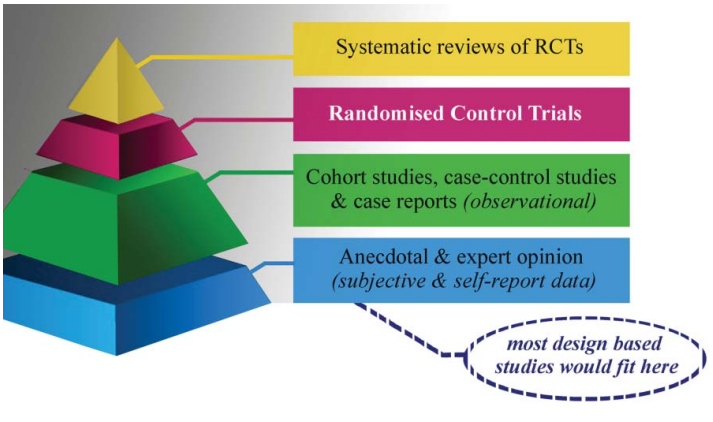

Figure 1. The evidence hierarchy within evidence-based medicine and its relationship to disciplinary research methods typically employed within design-based research.

conducted within the built environment since our contemporary model for understanding how individuals respond to their built environment is one of subjectivity. A person's perception of a particular space arises from an interplay between their 'internalized response and sensibilities, and the external realities of the space itself' (Littlefield 2007b, 139; also see Norman 2004).

This paper does not aspire to discredit the current practices of EBD but to encourage researchers within this field to confront the limitations of current ontological positions and research practices. EBD could benefit from a greater willingness to acknowledge the shortcomings of contemporary research methodologies and from adopting lessons from EBM. The evolution of EBM makes clear that evidence-based practice should not be valued above traditional disciplinary research, or necessarily be used as an argument to fundamentally alter the way that professionals practice. Evidence should instead be viewed as a tool to complement the existing skill, intuitive practice and expert judgment of the architect. The currently accepted definition of EBM acknowledges that evidence-based practice must be balanced relative to clinician expertise, the context and expectations of the patient (Figure 2). This definition has evolved from the way that EBM was initially positioned, as representative of a paradigm shift in clinical practice. It was refined in response to fierce debate about what evidence-based practice meant for clinical practice, and what the appropriate reach of its influence should be (Sackett et al. 1996). A similar debate has yet to take place within the field of EBD. This paper begins that discussion. It hopes to provoke a more serious consideration of the future potential and direction of this field of research.

Origins, complexities and limitations within evidence-based design research

According to Dickinson, the idea that human decision-making could be underpinned by rationality instead of intuition emerged between First World War and Second World War. The need for this approach was grounded in a desire to

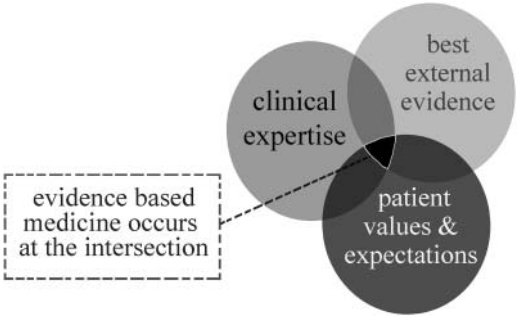

Figure 2. The contemporary model for understanding of evidence-based medicine and its relationship to clinical practice.
Source: Image adapted from Armstrong (2003).

guard against both the misplaced faith in the 'rationality of the free market' and the 'dangers of abandoning democratic checks and balances.' The contributions made by the social sciences to military and industrial war efforts during this period – developments such as decision analysis, systems analysis, cybernetics and operations research lent confidence to the belief that 'knowledge and expertise' could be employed in the rational and democratic reconstruction of society. Such developments sought to 'provide problem-solving rules … [in] an attempt to render decision-making fool proof' (2004, 43). While evidence-based findings are valued for their rationality and direct applicability to practice, if we interrogate this further, it is underpinned by a subjective assumption that evidence-based decision-making is better than alternative decision-making strategies. Haynes has observed that early advocates of EBM believed that clinicians whose practice was evidence-based would provide superior patient care as compared with 'practitioners who rely on an understanding of basic mechanisms and their own clinical experience' (2002, 2). He points out, however, that there are no studies capable of confirming this assumption and that it would be ethically impossible to carry out such a trial (Haynes 2002). Across various disciplinary fields, there is a consensus that rational decision-making may be suited to some types of decisions but not to all, and further that a professional cannot rely wholly on evidence in making decisions (Baker, Ginsburg, and Langley 2004; Haynes 2002; Khatri and Ng 2000; Sinclair and Ashkanasy 2005; Greenhalgh, Howick, and Maskey 2014). Furthermore, Baker, Ginsburg and Langley have highlighted the risk of transferring the value contemporarily attached to rationality onto the data collection methods we perceive to be rational. They caution that 'when norms of rationality are dominant, displaying the use of formal analysis procedures enhances legitimacy, even when such uses are instrumentally inappropriate' (2004, 94). Acknowledging the limitations of the evidence-based paradigm may be a critical first step toward the inclusion of a broader approach to health care environments research.

Dekker has advocated for research approaches that go 'up and out' instead of 'down and in'. The latter correlates with the type of research typically undertaken within EBD that aspires to a depth of understanding within a narrow scope (Dekker cited within Salmon, McClure, and Stanton 2012, 1834). These types of studies often strip out the complexity of a situation in order to focus on a specific, measurable effect. A shift toward 'up and out' within EBD would require an acknowledgement of the wider context within which this research occurs and the ways it is both shaped and limited by that context. This section will examine the limitations of EBD in its contemporary form including the relevance of testing isolated variables for deployment within a complex architectural setting and the hazards of incomplete evidence. Issues related to subjectivity will also be interrogated: the reduced value accorded to subjective responses, the difficulties of accounting for these within research and the extent to which new research

tools and methods (such as those from neuroscience) are underpinned by a degree of subjectivity that is largely unacknowledged.

In adopting the value system that underpins EBM, EBD places subjective self-report data at the opposite end of the value spectrum from more objective study methods such as RCTs. This overlooks the fact that pain, anxiety and architectural space are all experienced subjectively (Sobo, Eng, and Kassity-Krich 2006; Littlefield 2007a). Studies conducted with oncology patients confirm that feelings of depression and anxiety can impede the healing process (Johnson et al. 2008), suggesting that the value of self-perceived health measures should not be underestimated. While this knowledge should challenge the logic of undervaluing self-report data regarding the alleviation of anxiety, there remains pressure for researchers to confirm that self-perceived benefits to wellbeing translate into measurable physiological improvements. Animal-assisted therapy (AAT) provides an interesting case study relative to this issue. Quasi-experimental research regarding AAT interventions show that patient self-reports of reduced anxiety are almost always positive; however, few studies can match self-report data with physiological evidence from blood pressure, heart and respiratory rates (Cole and Gawlinski 2000; Johnson et al. 2008; Braun et al. 2009). This limitation raises the question of how the cost and/or inconvenience of interventions that patients perceive to be beneficial can be justified when a therapeutic return on investment cannot be conclusively stated. As Williams and Garner have astutely observed 'the absence of evidence of effectiveness is not the same as absence of effectiveness' (2002, 8). This also challenges the reliability of the methods and measures we are currently employing; are they sophisticated enough to accurately gauge benefits to wellbeing?

To understand the relationship between the built environment and a reduction in anxiety, researchers rely on proxies – physiological measures that are linked to hypothesized thought processes. In EBD commonly used measures include heart rate, blood pressure, salivary cortisol levels and galvanic skin response. Yet, despite recent advances in neuroscience, these hypothesized thought processes are still largely based on inferences of observed behaviour (Nanda et al. 2013). Studies in environmental psychology have given us a reasonable understanding of behavioural changes in response to particular environmental conditions. For example, the social withdrawal people exhibit when placed in situations that challenge their ability to regulate social contact, such as in high density accommodation (Baum and Davis 1980; Hogarth (2010) explains that while we can easily observe a person's actions it remains difficult to observe the thought processes that underpin those actions. As a result, investigators take subjective 'leaps of faith' in positing underlying models for the relationship between thought-process and behaviour, or thought-process and physiological outcome (Hogarth 2010, 338). The risk of relying on proxy measures is that the degree of subjectivity that underpins these studies is seldom acknowledged.

For example, Becker, Sweeny, and Parsons (2008) and Leather et al. (2003) both sought to understand whether the interior design of a waiting room can impact patient anxiety and perceptions of the quality of medical care they receive. While Becker, Sweeny, and Parsons (2008) examined a 'traditional' against a 'contemporary' waiting room design, Leather et al. (2003) measured patient responses to a waiting room pre- and post-refurbishment. Both studies found that self-reported stress decreased in the contemporary/refurbished waiting room spaces and concluded that interior design can somehow buffer the negative effects of stress associated with a hospital visit. Leather et al. (2003) have posited the hypothesis that patients perceive a correlation between the attention paid to the design of the space and the attention that will be given to their care. Despite the compelling logic of this supposition, it is nonetheless a subjective leap of faith on the part of the researchers as we do not yet have tools sophisticated enough to assess its accuracy.

There is much enthusiasm for integrating new tools and research methodologies from the field of neuroscience into EBD studies to better understand human–environment interactions.[2] Yet, the incorporation of scientific tools and methods lends an impression of objectivity, elevating the perceived reliability of emergent methods at the expense of traditional methods (such as survey responses) where subjectivity is more easily identified. Nanda et al. (2013) have suggested, for example, that functional magnetic resonance imaging (fMRI) will enable us to embark on new kinds of research that could not previously be contemplated. There is reason to be sceptical about the reliability of new research tools. Vul et al. (2009) scrutinized the data analysis methods of 53 fMRI studies, published in scientific journals between 2001 and 2008 (favouring those with high impact), that sought to measure emotion, personality and social cognition. Across the various data analysis methods utilized, more than half of the investigators employed methods that favoured results that correlated with the behavioural measure they were interested in. This conflated the significance of their findings. While these studies suffered from the limitation of subjective inference, Vul et al. (2009) argued this was being overlooked, in part, because journal reviewers were unfamiliar with the emergent, increasingly complex methods used to analyse the data. In their opinion, had the same studies been presented with data gained using traditional methods, such as questionnaires or behavioural measures, then reviewers would have been alert to these subjective limitations.

The RCT is considered the gold standard of objective research methodologies in medicine. Within health care RCTs are used in an effort to isolate the efficacy of a particular medical intervention, they measure and compare outcomes between an intervention group and a control group, while minimizing, as far as practicable, the differences between the two groups under investigation. A common criticism of EBM is its reliance on the RCT that, critics argue, strip out the intractability of 'real world' medical practice (Savransky and Rosengarten 2016).

For example, RCTs will commonly exclude the following factors: patients forgetting to take medication at appropriate intervals (Brown and Bussell 2011), eating foods that reduce the effectiveness of a particular drug (Bushra, Nousheen, and Khan 2011) or neglecting to follow a physical rehabilitation process as prescribed (Jack et al. 2010), while controlling for factors such as weight, age and comorbidity. In testing medical interventions under optimum circumstances, the diverse social, economic, infrastructural and cultural circumstances that will ultimately determine the effectiveness of that intervention are unaccounted for, giving rise to questions around the ultimate relevance and applicability of the corresponding findings to medical practice (Savransky and Rosengarten 2016). For this reason, RCT findings are seen as less useful for practitioners than findings from applied research because this knowledge is not as well suited to the specific, complex clinical problems faced in practice (Haynes 2002; Greenhalgh, Howick, and Maskey 2014). When the RCT method is translated into an architectural context, this can result in studies that pinpoint the effects of an isolated feature, such as paint colours, light levels, exterior views, equipment or furniture placement. This excludes much of the atmospheric richness of an architectural interior because it excludes the interplay of elements that contribute to the way people respond to a space. As Littlefield has observed:

> buildings are, more or less, psychological entities … skeletons on which we hang notions of self, society, status, heritage, value … buildings live most powerfully in the mind and we constantly process them, assimilate them and digest them … We constantly invest buildings with meaning. (2007a, 9)

A pilot study by Gray et al. provides an example of the limitations of translating the RCT into studies of the built environment. Their study examined the influence of paint colours and lighting on the 'stress, alertness and satisfaction' of nursing students during the performance of a simulated cardiac resuscitation. In testing performance between a control space and an intervention space, the researchers concluded that 'changes of spatial colour patterning, wall colour, and full-spectrum lighting have a positive effect on alertness and stress levels' (2012, 58). However, in focusing on only two architectural elements (paint colours and light levels, alongside equipment placement), this methodological approach overlooked a number of existing features of the space that may also have contributed to the response of the user group. Photographs of the control space confirmed that the room had no natural light or exterior views, flooring had a busy, high-contrast pattern and the arrangement of medical equipment within the space appeared ad hoc and messy – computer screens were perched on office furniture amid a mess of technology cables. It is worth noting that similar photographs were not published for the intervention space. While the aspects listed above were not commented on within the published study, they are worthy of consideration in light of research that suggests some people will

respond adversely to the presence of clutter. Carter (2012) has suggested that clutter bombards us with excessive stimuli, distracts our attention and frustrates us by preventing us from locating what we need to find quickly. Although the RCT trial sought to locate critical medical equipment to make it easier to access, the authors did not comment on what further steps were taken (if any) to declutter the control and intervention rooms more generally. This raises the question of the relevance of these types of findings for architectural practice and, as Greenhalgh, Howick, and Maskey (2014) have asked within the field of medicine, how much thought is being given to the usability of such findings for practitioners, and to what end.

The approach of testing isolated properties one at a time is widely accepted within research. Relative to EBD, Nanda et al. have argued that this logic is sound in the pursuit of 'evidence-based building blocks for design practice' (2013, 74). However, Bennis and O'Toole, scholars of management theory, have challenged this approach, arguing that 'gradual accumulation of tiny facts' in the pursuit of greater scientific understandings does little but force practitioners to make decisions based on the limited information available to them (2005, 100). The complexity of the built environment provides a further challenge. Architecture is a practice of trading concessions in one area for benefits in another; it is the art of balancing spatial, functional, performance and budgetary requirements with atmospheric qualities. An RCT approach overlooks the fact that responses to architectural space are not produced by isolated elements but relative to the way that all of the elements within an environment operate in accord. Likewise, Greenhalgh, Howick and Maskrey have pointed out the increasing unsuitability of this approach for the medical field where 'the patient with a single condition that maps unproblematically to a single evidence based guideline is becoming a rarity' (2014, 3727). Within studies of the built environment, the RCT approach is incapable of accounting for the fact that two architects responding to the same set of client specifications will create spaces that look and feel entirely different. The Maggie's Centres (UK) illustrate this most clearly. Twenty-two architects responding to the same functional brief (albeit in different geographical locations) produced 22 substantially different aesthetic responses.[3] Two recently constructed paediatric hospitals designed in Australia provide a further example that two architectural practices responding to similar functional briefs will offer solutions at different ends of the atmospheric spectrum. The Royal Children's Hospital (Melbourne) provides a predominantly white walled interior with richly detailed wayfinding graphics, whilst the Lady Cilento Children's Hospital provides richness through its use of natural timber wall linings and a more abstract, boldly coloured approach to wayfinding (Figure 3). For architects to confidently rely on evidence-based building blocks, these would need to be tested in relation to a vast number of environmental variables that is wholly impractical.

Bennis and O'Toole have suggested that where evidence is incomplete, professionals are liable to 'overweight' the value of the knowledge that is available

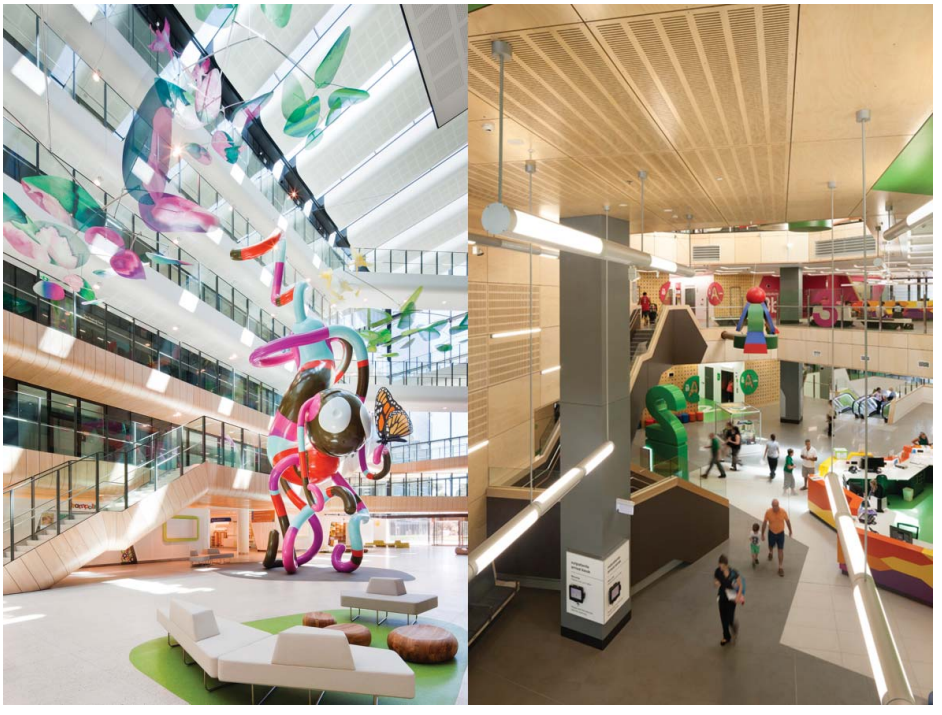

Figure 3. Aesthetic design variances between the atrium interiors at the Royal Children's Hospital (Melbourne, 2011, designed by Billard Leece Partnership with Bates Smart, Photo © Shannon McGrath, shown at left) and the Lady Cilento Children's Hospital (Brisbane, 2014, designed by Lyons with Conrad Gargett, shown at right, Photo ©Dianna Snape).

(2005, 100). The single versus multiple occupancy room debate provides a useful example of this. The provision of single rooms is broadly regarded as best practice within contemporary hospital construction owing to the perception that single rooms are superior with regard to infection control, while offering greater affordances for family engagement (Chaudhury, Mahmood, and Valente 2006). However, insufficient research is available to enable a full appreciation of the wider implications of this move. Only a few studies have examined the staffing implications of single rooms (Florey, Flynn, and Isles 2009; Verderber and Todd 2012; Chaudhury, Mahmood, and Valente 2006; Maben et al. 2015), or the loss of social support to patients and their families (Curtis and Northcott 2016; Miller, Freeman, and Coupey 1998; Maben et al. 2015; Rollins 2009). Single rooms also come with higher cost implications in their construction and maintenance (single rooms entail a higher cleaning burden) alongside challenges to nursing supervision (Verderber and Todd 2012; Chaudhury, Mahmood, and Valente 2006; Maben et al. 2015). Despite the clear limitations that preclude us from weighing all of the considerations with respect to this issue, the percentage of single rooms offered within the construction of a new hospital is often marketed to the public as an indicator of cutting edge hospital design and a signifier of a high quality of care (O'Hare 2014; Vogler 2014; CHLA 2011).

Bradley and Field have cautioned that 'it is a short step from *without substantial evidence* to *without substantial value*' (1995, 838; emphasis original). Traditional disciplinary research methods have been undervalued within the field of EBD owing to the high value placed upon evidence in decision-making, alongside a lack of acknowledgement of the degree of subjectivity present within the research methods currently favoured. This has been exacerbated in the translation of a research paradigm from medicine to design without any serious interrogation of whether the rules and conditions that determine knowledge production within EBM are relevant to the practice of design.

Reaffirming value for design-based research methods

Medical practice, and by association the environments designed for the delivery of health care, are characterized by fast-paced, technological change and decision-making based on information that may be inadequate or incomplete. This matches Sinclair and Ashkanasy's (2005) definition of an 'environment of uncertainty' and correlates closely with Khatri and Ng's (2000) definition of an 'unstable environment' (where a number of variables are unknown). Within these types of environments, intuitive decision-making has been found to result in superior choices relative to evidence-based decision-making (Khatri and Ng 2000; Sinclair and Ashkanasy 2005). That intuition is broadly acknowledged as a central component of architectural practice (Lundin 2010; Gehry 2007) forms part of the reason why design-based research methodologies are undervalued within the context of EBD. Importantly, however, Khatri and Ng have pointed out that while intuition emerges from a subconscious process it is 'not the opposite of rationality' but the ability to employ intuitive decision-making with confidence and success that emerges from years of experience solving problems within a particular field (2000, 59). Or, as Perot has phrased it, intuition is 'bring [ing] to bear on a situation everything you've seen, felt, tasted and experienced' in the context of professional practice (Perot cited within Khatri and Ng 2000, 59). Whether in management, medicine or architecture, intuition can allow 'the totality of a given situation' to be apprehended, enabling a 'holistic perception… that transcends rational ways of knowing' (Khatri and Ng 2000, 60).

Design research and speculative design are research methods traditionally employed within the discipline of architecture. They offer different ways of seeing and approaching contemporary challenges within the design of health care facilities, networks and systems, and for responding to problems where the very boundaries that define a problem are unstable or unknown. Design research, according to Edelson's definition, has the capacity to generate new theories that 'could not be generated either by isolated analysis or traditional empirical approaches' (2002, 118). Design research 'exploits the design process' in order to advance understanding. This typically includes the identification of a design problem that responds to a goal, need or opportunity, that addresses the

'challenges, constraints and opportunities presented by the design context', that is then responded to through 'iterative cycles of design and implementation, using each implementation as an opportunity to collect data to inform subsequent design' (2002, 118). Speculative design is a form of design research that provides a way to project forward, to imagine new possibilities and use those possibilities to critique accepted practice. This is achieved via this methodologies provision of artefacts – imagined solutions to contemporary and future design problems that enable critical reflection on accepted design practice and the expectations we hold with reference to this (Dunne and Raby 2001; DiSalvo 2012; Auger 2013). While design research embraces real-world constraints, speculative design allows us to temporarily suspend these constraints, to imagine new possibilities beyond them. This provides a strategy for identifying which particular constraints are limiting progress with respect to the design of health care environments and thus to direct resources toward addressing those constraints.

Design-based research methods rely on design thinking. Nancy Nersessian has provided a useful metaphor for the logic that underpins design thinking. In her delineation of creative thinking from ordinary problem solving, Nersessian suggests that this is akin to the difference between flying a plane and 'building the plane while it is flying – with only a vague idea of what a flying vehicle might look like' (2012, 220). Contemporary health care facilities represent a complex design problem. One that is difficult to make sense of owing to incomplete, contradictory, interdependent or changing requirements. Design provides a strategy for responding to these types of problems. In explaining the difference between designerly versus non-designerly ways of thinking, Dunne and Martin (2006) have observed that designers reject the expectation that a problem will necessarily be recognizable, or that it will be solvable through the application of existing disciplinary methods and expertise. A designerly approach is more likely to seek cross-disciplinary collaboration, require an intimate understanding of the needs of the end user and recognize that deductive and inductive reasoning must be combined with idea generation. Dorst (2011) has referred to the logic

	What		How		Result
Deduction	Thing	+	Working principle	=	?
Induction	Thing	+	?	=	Observed behaviour
Abduction	?	+	?	=	Value specification

Figure 4. Differences between inductive, deductive and abductive thinking.
Source: Image adapted from Dorst (2011).

that underpins design thinking as 'abduction' (Figure 4). Ultimately, however, Dunne and Martin (2006) suggest that the value of design thinking is situated within the practice of taking inspiration from the very constraints and conflicting requirements that make problems difficult to solve. At a time when disciplines as diverse as education and marketing are eagerly embracing design thinking (Bennett, Agostinho, and Lockyer 2016; Dunne and Martin 2006, Dorst 2011; Ungaretti et al. 2009), the field of EBD subscribes to a value system that overlooks the benefits of this approach.

In elucidating how architects manage complex design problems, Dorst (2011) explains that they will often bring a 'frame' to a problem, and this acts as a sense-making tool to guide decision-making. Frames take the form of a suitable solution translated from a different, or unlikely, context. Dorst gives the example of applying the known strategies for delivering a successful music festival to reduce the incidence of criminal behaviour within an inner city night club area. Directing effort to ensuring the crowd remained entertained during their night out, including the provision of timely transportation, crowd control, safety and wayfinding (known strategies from music festivals) removed the opportunity to become bored. This curbed the anti-social behaviour that was the root cause of the criminal behaviour (2011). The inclusion of a Meerkats zoo enclosure at the Royal Children's Hospital (Melbourne, Australia) provides an example of this way of working within health care environments design. Although there is no precedent for animal installations, aside from fish tanks within healthcare environments, the enclosure has been incorporated within the Specialist Clinic (out-patients) waiting area. What is known, however, is that a reasonable majority of children will be partial to visiting the zoo. The Meerkats enclosure thus provides an example of the kinds of solutions that are able to emerge when abductive and design thinking are employed within health care environments; solutions that could not be achieved through an analysis of existing solutions, or via studies of isolated variables.

Within the fields of product and interaction, design implementation refers to physically prototyped solutions. This is more difficult to achieve in architectural practice owing to the increased scale, cost and time commitment of prototyping parts of a building. Burnett and Evans' more recent definition of prototyping becomes useful in the context of the built environment. They suggest that prototyping is the process of making an idea public in some format (be that publishing a blog post, giving a presentation or creating an exhibition) that enables the maker to test how others respond to the idea and thus inform subsequent design iterations (see Vedanta, 2017). Speculative design has limitations, most importantly, that an artefact is not valuable in isolation. A speculative design response must take account of the complex context in which it seeks to (fictionally) exist, both during the process of creation, including gathering feedback through iterative testing, and be resituated within this context following completion. A process of critical interpretation is required to identify the useful, and perhaps usable, aspects of any design provocation. The artefact should be

related back to best practice and disseminated to the appropriate audiences. Tracing its subsequent influence is another important, but longitudinal, step within this process (Figure 5).

DiSalvo has been critical of speculative designs that 'leave us hungry for more critical engagement' (2012, 117). Specifically, projects that state a desire to initiate change but fail to direct what form or purpose that change should take, and those which produce a 'surface reflection' without reference to the 'activities, values, techniques, histories, traditions, and controversies' of a particular design problem (2012, 116). Speculations that fail to address politics in social contexts are a 'missed opportunity' for DiSalvo who suggests that 'engaging with … the political could lend speculative design projects tractability and fodder for dialogue and debate' (2012, 118). Auger has highlighted the element of 'spectacle' itself as posing a danger relative to the value accorded to speculative design. To overcome this, he suggests a process for 'craft[ing] the speculation into something more poignant': acknowledging the rules that govern practice within a given context, do not stray too far into the future, and tailor to the 'complex and subtle requirements of an identified audience' (2013, 12). To achieve this, interdisciplinary collaboration is required. While Auger suggests scientists as natural collaborators, within the field of EBD patients, clinicians, psychologists and biomedical engineers may be more fitting choices. DiSalvo has similarly observed:

Figure 5. An example of a speculative design project for palliative care. Sarah Lam Po Tang offers a speculation on the co-location of a 12-bed palliative care facility with the Victorian College of the Arts (Melbourne University's faculty of performing and fine arts). Located within a bustling inner city university campus, the project critiques societies' tendency to place palliative care out of sight while seeking greater leverage of the recognized benefits of music and art therapy programmes for this patient cohort. The project was created through interdisciplinary engagement with architects experienced in hospital design, clinician researchers, practising clinicians, environmental psychologists and cancer experiences researchers.

> If an object of speculative design does not provide access to a breadth or depth of subject matter, then we should be careful about making claims for its capacity to foment or support substantive reflection. (2012, 119)

Markauskaite and Goodyear's (2016) differentiation of various forms of inquiry into the categories of projective, productive and illuminative is useful in elucidating the limitations of the research methods commonly employed within EBD. Productive inquiry is characterized by practices of knowledge-generation gained through observing phenomena. This results in specifications for best practice. Almost all of the research currently valued within the field of EBD falls within this category. Illuminative inquiry is that which produces knowledge by examining a phenomenon within its broader context, for example, interviews with health care designers that account for the full complexities of practice, including budgets, deadlines and inter-personal challenges would fit within this category. While research of this type would allow us to see the actual limitations of implementing best practice in EBD, very little of this type of research is currently undertaken within the field. Projective inquiry is that which seeks improvement and innovation rather than reflecting on existing, habitual practices. Although, strictly following the definition provided by Markauskaite and Goodyear (2016), EBD research could be seen to overlap with projective inquiry, this paper argues for a greater differentiation between productive and projective that sees projective inquiry as a form of visionary practice; that seeks new ways of looking at existing problems instead of seeking iterative improvements in current practices. In relation to biomedical research, sociologists Savransky and Rosengarten have suggested that 'speculative dreaming' allows us to 'think alongside situations, practices and experiences that prevailing regimes of evidence would deem improbable, artifactual or confounding'; to 'transform the horizon of possibilities' (2016, 172). Design-based research methodologies provide a low-cost, low-risk, collaborative research strategy that enables us to project forward and move beyond existing preconceptions; they thus provide a complementary research approach to the methods currently employed within health care environments research. These methods should be accorded a higher value.

Conclusion

The high value placed upon evidence with regard to decision-making within the research, design and construction of contemporary health care environments is a consequence of the value that is contemporarily placed on evidence-based decision-making. The result has been a relative debasement of the value accorded to traditional, disciplinary research methods. This has been exacerbated by the application of a specific research paradigm from medicine to design without any serious interrogation of whether the rules and conditions that determine knowledge production within EBM are relevant to the practice of design. A paradigm that places subjective self-report data at the opposite end of

a value to scale to studies that follow an RCT method, or that seek validation primarily through physiological evidence, presents a misfit for research conducted within health care environments. Subjective methods are highly relevant to research within this field precisely because human responses to architectural space, alongside perceptions of anxiety and pain are subjective experiences. EBD can adopt a meaningful lesson from EBM in being quicker to acknowledge that evidence-based practice should not be valued above traditional disciplinary research, or to fundamentally alter the way that professionals practice. Evidence has value but it should be utilized as a tool to complement the existing skill, intuitive practice and expert judgment of the architect.

Environments characterized by fast-paced technological change, contradictory, interdependent or changing requirements and information that may be inadequate and/or incomplete are better suited to intuitive decision-making practices over those which are evidence-based. Design-based research methods can contribute valuably to this field. They allow new and previously unconsidered solutions to emerge; enable a critique of accepted design practice and serve to identify the particular constraints that may be limiting progress within a field so that resources can be directed toward overcoming these constraints. Design-based research methods offer a low-cost, low-risk, collaborative research strategy capable of providing the types of findings that cannot be achieved through the analysis of existing solutions, or via studies of isolated variables. They should be accorded more value as relevant and complementary to the methods currently employed within health care environments research that could productively challenge existing approaches to the contemporary design of health care facilities. A broader, more inclusive disciplinary approach to health care environments research should be embraced.

Notes

1. EBM emerged from McMaster University (Ontario) in 1992 with the work of the Evidence Based Medicine Working Group (refer Champagne, Lemieux-Charles and McGuire, 2004). While Ulrich's 1984 study, 'View through a window may influence recovery' is broadly accepted as the formative study within the field of EBD, The Centre for Health Design, a driving force within this field of research, was not formed until 1993; https://www.healthdesign.org/about-us accessed: 12 January 2017.
2. The creation of associations like the Academy of Neuroscience for Architecture (formed in 2003) attest to this: http://www.anfarch.org/mission/ date accessed: 19 January 2017.
3. To review the various Maggie's Centre designs, refer: https://www.maggiescentres.org/our-centres/

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References

Armstrong, E. C. 2003. "Harnessing New Technologies While Preserving Basic Values." *Families, Systems, & Health* 21 (4): 351–356.

Auger, J. 2013. "Speculative Design: Crafting the Speculation, Digital Creativity." 24 (1): 11–35. doi:10.1080/14626268.2013.767276

Baker, G. R., L. Ginsburg, and A. Langley. 2004. "An Organizational Science Perspective on Information, Knowledge, Evidence, and Organizational Decision-making." In *Using Knowledge and Evidence in Healthcare*, edited by F. Champagne L. Lemieux-Charles, and W. McGuire, 86–114. Toronto: University of Toronto Press.

Baum, A., and G. E. Davis. 1980. "Reducing the Stress of High Density Living: An Architectural Intervention." *Journal of Personality and Social Psychology* 38 (3): 471–481. doi:10.1037/0022-3514.38.3.471.

Becker, F., B. Sweeny, and K. Parsons. 2008. "Ambulatory Facility Design and Patients Perceptions of Healthcare Quality." *Health Environments Research and Design Journal* 1 (4): 35–54. doi:10.1177/193758670800100405.

Bennett, S., S. Agostinho, and L. Lockyer. 2016. "The Process of Designing for Learning: Understanding University Teachers' Design Work." *Educational Technology Research and Development* 65 (1): 1–21. doi:10.1007/s11423-016-9469-y.

Bennis, W. G., and J. O'Toole. 2005. "How Business Schools Lost their Way." *Harvard Business Review* 83 (5): 96–104.

Bradley, F., and J. Field. 1995. "Evidence Based Medicine." *Lancet* 346 (8978): 838–839.

Braun, C., T. Stangler, J. Narveson, and S. Pettingell. 2009. "Animal-Assisted Therapy as a Pain Relief Intervention for Children." *Complementary Therapies in Clinical Practice* 15 (2): 105–109. doi:10.1016/j.ctcp.2009.02.008.

Brown, M. T., and J. K. Bussell. 2011. "Medication Adherence: WHO Cares?" *Mayo Clinic Proceedings* 86 (4): 304–314. doi:10.4065/mcp.2010.0575.

Bushra, R., A. Nousheen, and A. Y. Khan. 2011. "Food-Drug Interactions." *Oman Medical Journal* 26 (2): 77–83. doi:10.5001/omj.2011.21.

Carter, S. B. 2012. "Why Mess Causes Stress: The Mental Cost of Clutter." Accessed 2 February 2017. https://www.psychologytoday.com/blog/high-octane-women/201203/why-mess-causes-stress-8-reasons-8-remedies.

Champagne, F., L. Lemieux-Charles, and W. McGuire. 2004. "Towards a Broader Understanding of the Use of Knowledge and Evidence in Health Care." In *Using Knowledge and Evidence in Healthcare*, edited by F. Champagne, L. Lemieux-Charles, and W. McGuire, 3–17. Toronto: University of Toronto Press.

Chaudhury, H., A. Mahmood, and M. Valente. 2006. "Nurses' Perceptions of Single-Occupancy versus Multiple Occupancy Rooms in Acute Care Environments: An Exploratory Comparative Assessment." *Applied Nursing Research* 19 (3):118–125. doi:10.1016/j.apnr.2005.06.002.

CHLA (Children's Hospital Los Angeles). 2011. "Introducing the Marion and John E. Anderson Pavilion." Accessed 12 May 2017. http://www.chla.org/blog/hospital-news/introducing-the-marion-and-john-e-anderson-pavilion.

Cole, K. M., and A. Gawlinski. 2000. "Animal-assisted Therapy: The Human-animal Bond." *AACN Clinical Issues: Advanced Practice in Acute & Critical Care* 11 (1): 139–149.

Curtis, P., and A. Northcott. 2016. "The Impact of Single and Shared Rooms on Family Centered Care in Children's Hospitals." *Journal of Clinical Nursing* 26 (11–12): 1584–1596. doi:10.1111/jocn.13485.

Dickinson, H. 2004. "A Sociological Perspective on the Transfer and Utilization of Social Scientific Knowledge for Policy Making." In *Using Knowledge and Evidence in Healthcare*, edited by F. Champagne, L. Lemieux-Charles, and W. McGuire, 41–69. Toronto: University of Toronto Press.

DiSalvo, C. 2012. "FCJ-142 Spectacles and Tropes: Speculative Design and Contemporary Food Cultures." *The Fibre Culture Journal* 20: 102–122.

Dorst, K. 2011. "The Core of 'Design Thinking' and its Application." *Design Studies* 32 (6): 521–532. doi:10.1016/j.destud.2011.07.006.

Dunne, D., and R. Martin. 2006. "Design Thinking and How it will Change Management Education: An Interview and Discussion." *Academy of Management Learning & Education* 5 (4): 512–523. doi:10.5465/AMLE.2006.23473212.

Dunne, A., and F. Raby. 2001. *Design Noir: The Secret Life of Electronic Objects*. Berlin: Birkhauser.

Edelson, D. C. 2002. "Design Research: What we Learn when we Engage in Design." *The Journal of Learning Sciences* 11 (1): 105–121. doi:10.1207/S15327809JLS1101_4.

Florey, L., R. Flynn, and C. Isles. 2009. "Patient Preferences for Single Rooms or Shared Accommodation in a District General Hospital." *Scottish Medical Journal* 54 (2): 5–8. doi:10.1258/rsmsmj.54.2.5.

Gehry, F. 2007. "Architecture and Intuition." In *The Architecture Reader: Essential Writings from Vitruvius to the Present*, edited by A. K. Sykes, 304–305. New York: George Braziller Publishers.

Gray, A. W., K. S. Kestern, S. Hurst, and L. Anderko. 2012. "Using Clinical Simulation Centers to Test Design Interventions: A Pilot Study of Lighting and Color Modifications." *Health Environments Research and Design Journal* 5 (3): 46–65. doi:10.1177/193758671200500306.

Greenhalgh, T., J. Howick, and N. Maskey. 2014. "Evidence Based Medicine: A Movement in Crisis?" *British Medical Journal* 348: 3725–3732. doi:10.1136/bmj.g3725.

Haynes, R. B. 2002. "What Kind of Evidence is it that Evidence-Based Medicine Advocates Want Health Care Providers and Consumers to Pay Attention to?" *BMC Health Services Research* 2 (1): 1–7. doi:10.1186/1472-6963-2-3.

Hogarth, R. M. 2010. "Intuition: A Challenge for Psychological Research on Decision Making." *Psychological Inquiry* 21 (4): 338–353. doi:10.1080/1047840X.2010.520260.

Jack, K., S. M. McLean, J. K. Moffett, and E. Gardiner. 2010. "Barriers to Treatment Adherence in Physiotherapy Outpatient Clinics: A Systematic Review." *Manual Therapy* 15 (3): 220–228. doi:10.1016/j.math.2009.12.004.

Johnson, R. A., R. L. Meadows, J. S. Haubner, and K. Sevedge. 2008. "Animal-Assisted Activity Among Patients with Cancer: Effects on Mood, Fatigue, Self-perceived Health, and Sense of Coherence." *Oncology Nursing Forum* 35 (2): 225–232.

Khatri, N., and H. A. Ng. 2000. "The Role of Intuition in Strategic Decision Making." *Human relations* 53 (1): 57–86. doi:10.1177/0018726700531004.

Leather, P., D. Beale, A. Santos, J. Watts, and L. Lee. 2003. "Outcomes of Environmental Appraisal of Different Hospital Waiting Rooms." *Environment and Behavior* 35 (6): 842–869. doi:10.1177/0013916503254777.

Littlefield, D. 2007a. "Introduction." In *Architectural Voices: Listening to Old Buildings*, edited by D. Littlefield andS. Lewis, 8–15. West Sussex: Wiley-Academy.

Littlefield, D. 2007b. "Milky Voids – the Reinterpretation of a Mining Building." In *Architectural Voices: Listening to Old Buildings*, edited by D. Littlefield and S. Lewis, 136–141. West Sussex: Wiley-Academy.

Lundin, S. 2010. "Purely Scientifically Speaking." In *Architecture as Medicine: The Importance of Architecture Treatment for Outcomes in Psychiatry*, edited by L. Rom and S. Lundin, 227–244. Stockholm: ARQ.

Maben, J., P. Griffiths, C. Penfold, M. Simon, E. Pizzo, J. Anderson, G. Robert, et al. 2015. "Evaluating a Major Innovation in Hospital Design: Workforce Implications and Impact on Patient and Staff Experiences of All Single Room Hospital Accommodation." *Health Services and Delivery* 3 (3). https://www.ncbi.nlm.nih.gov/books/NBK274435/

Markauskaite, L., and P. Goodyear. 2016. *Epistemic Fluency and Professional Education: Innovation, Knowledgeable Action and Actionable Knowledge*. Dordrecht: Springer.

Miller, N., S. Freeman, and S. Coupey. 1998. "Adolescent Preferences for Rooming During Hospitalization." *Journal of Adolescent Health* 23 (2): 89–93. doi:10.1016/S1054-139X(98)00015-9.

Muhlbauer, B. H. 2013. "The 'Added Value' of Good Hospital Architecture for Personnel – an Economic Perspective." In *Healing Architecture*, edited by N. Nickl-Weller and H. Nickl, 206–222. Schweiz: Braun Publishing.

Nanda, U., D. Pati, H. Ghamari, and R. Bajema. 2013. "Lessons from Neuroscience: Form Follows Function, Emotions Follow Form." *Intelligent Buildings International* 5 (1): 61–78. doi:10.1080/17508975.2013.807767.

Nersessian, N. J. 2012. "Engineering Concepts: The Interplay Between Concept Formation and Modelling Practices in Bioengineering Sciences." *Mind, Culture, and Activity* 19 (3): 222–239. doi:10.1080/10749039.2012.688232.

Norman, D. A. 2004. *Emotional Design: Why we Love (or Hate) Everyday Things*. New York: Basic Books.

O'Hare, P. 2014. "S.A. Hospitals Gravitate Toward Private Patient Rooms." *San Antonio Express-News*, April 28.

Rollins, J. A. 2009. "The Influence of Two Hospitals Designs and Policies on Social Interaction and Privacy as Coping Factors for Children with Cancer and their Families." *Journal of Pediatric Oncology Nursing* 26 (6): 340–353. doi:10.1177/1043454209339734.

Sackett, D. L., W. M. Rosenberg, J. M. Gray, R. B. Haynes, and W. S. Richardson. 1996. "Evidence Based Medicine: What it is and What it isn't." *British Medical Journal* 312 (7023): 71–72. doi:10.1136/bmj.312.7023.71.

Salmon, P. M., R. McClure, and N. A. Stanton. 2012. "Road Transport in Drift? Applying Contemporary Systems Thinking to Road Safety." *Safety Science* 50 (9): 1829–1838. doi:10.1016/j.ssci.2012.04.011.

Savransky, M., and M. Rosengarten. 2016. "What is Nature Capable of? Evidence, Ontology and Speculative Medical Humanities." *Medical Humanities* 42 (3): 166–72. doi:10.1136/medhum-2015-010858.

Sinclair, M., and N. M. Ashkanasy. 2005. "Intuition: Myth or Decision-Making Tool?" *Management Learning* 36 (3): 353–370. doi:10.1177/1350507605055351.

Sobo, E. J., B. Eng, and N. Kassity-Krich. 2006. "Canine Visitation (Pet) Therapy Pilot Data on Decreases in Child Pain Perception." *Journal of Holistic Nursing* 24 (1): 51–57. doi:10.1177/0898010105280112.

Ulrich, R. 1984. "View Through a Window May Influence Recovery." *Science* 224 (4647): 224–225. doi:10.1126/science.614340

Ungaretti, T., P. Chomowicz, B. J. Canniffe, B. Johnson, E. Weiss, K. Dunn, and C. Cropper. 2009. "Business + Design: Exploring a Competitive Edge for Business Thinking." *SAM Advanced Management Journal* 7 (3): 4–11.

Vedanta, S (for NPR). 2017. "Hidden Brain, Episode 56: Getting Unstuck." Accessed January 3, 2017. http://www.npr.org/podcasts/510308/hidden-brain

Verderber, S., and L. G. Todd. 2012. "Reconsidering the Semiprivate Inpatient Room in U.S. Hospitals." *Health Environments Research and Design Journal* 5 (2): 7–23. doi:10.1177/193758671200500202

Vogler, S. 2014. "Lady Cilento Children's Hospital will Open on November 29." *The Courier Mail*, October 2.

Vul, E., C. Harris, P. Winkielman, and H. Pashler. 2009. "Puzzlingly High Correlations in fMRI Studies of Emotion, Personality, and Social Cognition." *Perspectives on Psychological Science* 4 (3): 274–290. doi:10.1111/j.1745-6924.2009.01125.x.

Williams, D. D. R., and J. Garner. 2002. "The Case Against 'The Evidence': A Different Perspective on Evidence Based Medicine." *The British Journal of Psychiatry* 180 (1): 8–12. doi: 10.1192/bjp.180.1.8